

Amplitude

'862 Claim 13: "Amplitude"

13. A method of processing multiple wavelengths of light, the method comprising:

... reflecting the first portion of optical signal wavelengths from the moveable mirror to form at least one MEMS output signal having an amplitude, the amplitude of the MEMS output signal capable of being changed by moving the moveable mirror. . .

'862 Claim 13: "to form at least one MEMS output signal having an amplitude"

Cheetah's Construction

An output signal is light reflected off of the MEMS device received at the output interface

Defendants' Construction

To form an output signal using a MEMS device that causes interference between light beams

as 60 % (02/9/2025) Document 11-5 Filed 03/11/20 Page 31 of 31 Page ID # 3144

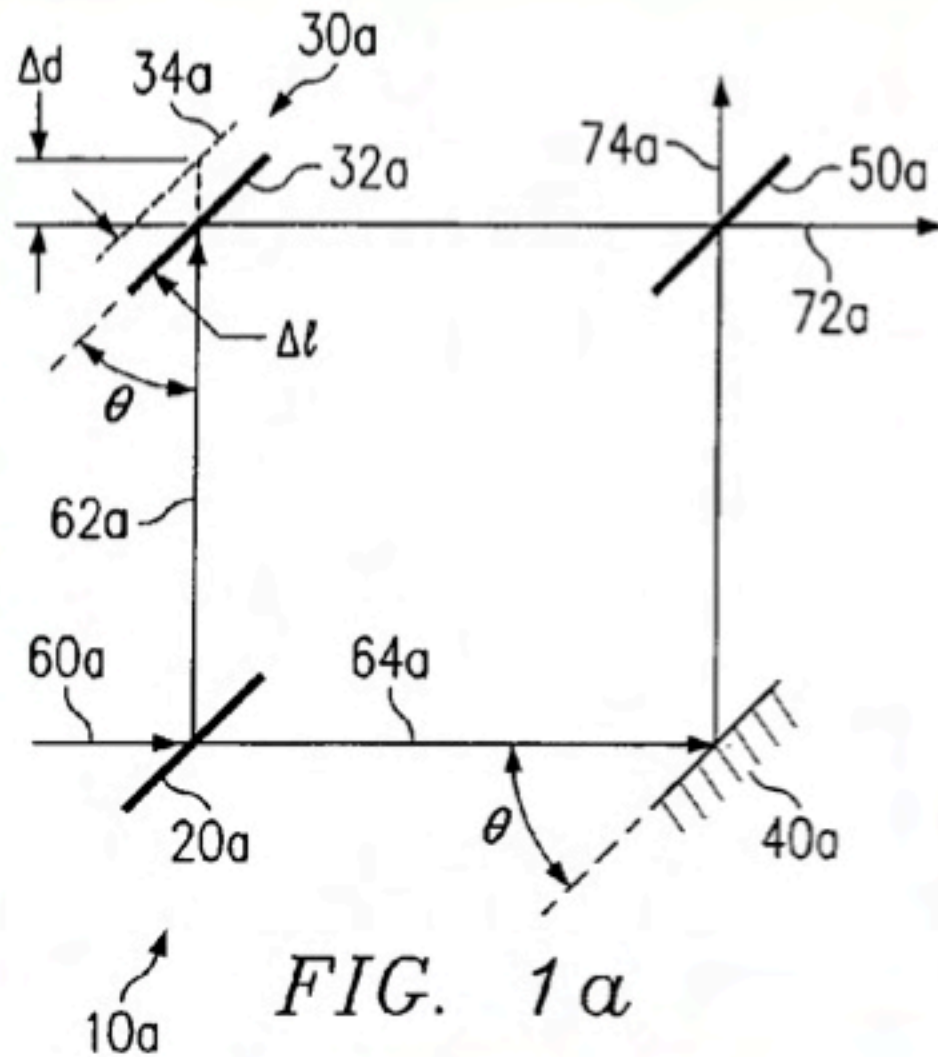
'862 Claim 13: "the amplitude of the MEMS output signal capable of being changed by moving the moveable mirror"

| Cheetah's Construction | Defendants' Construction |
|--|--|
| As the position of the movable mirror changes, the amplitude of the output signal changes | Movement of the mirror capable of causing phase shift to change the amplitude of the MEMS output signal |

Cheetah's Construction Is No Construction

| Claim Term | Cheetah's Construction |
|--|---|
| <p>“The amplitude of the MEMS output signal capable of being changed by moving the moveable mirror”</p> | <p>As the position of the movable mirror changes, the amplitude of the output signal changes</p> |

Figure 1a is a Building Block in the '862 patent

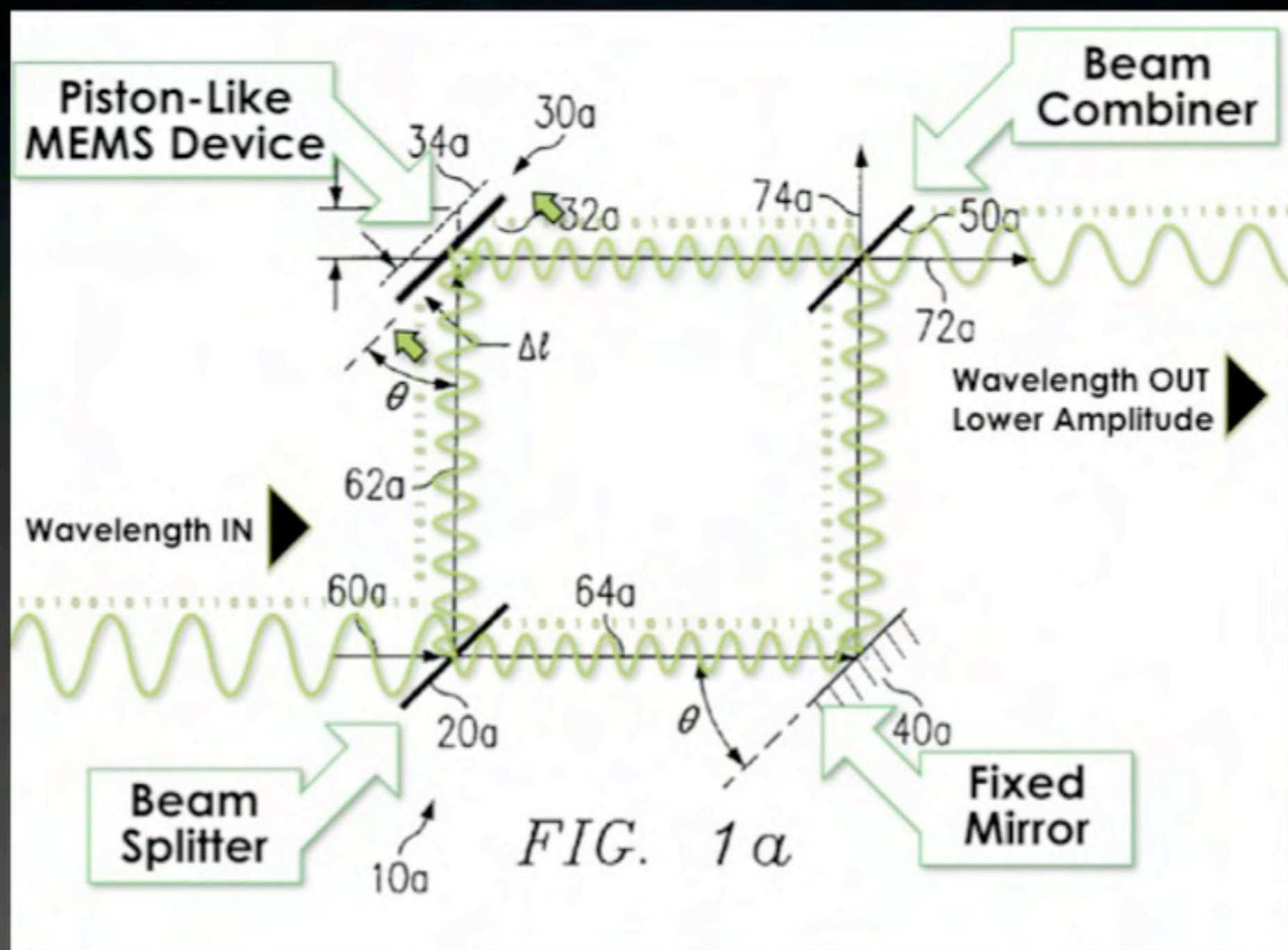


DETAILED DESCRIPTION OF THE INVENTION

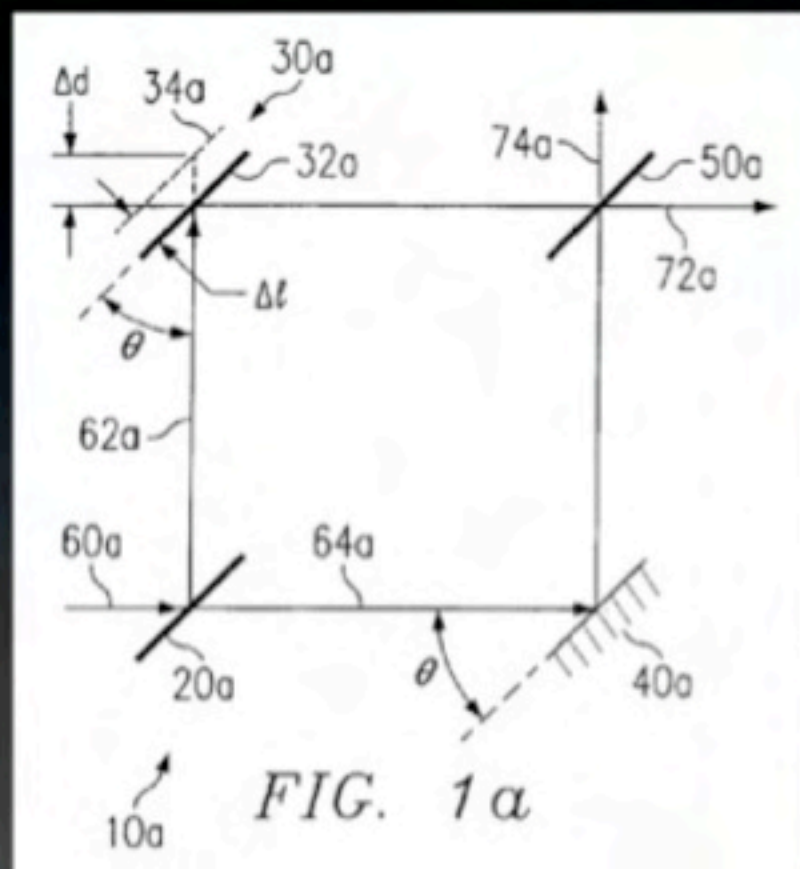
I. Building Blocks for High Speed Optical Signal Processing

'862 Patent, col. 4 ll. 45.

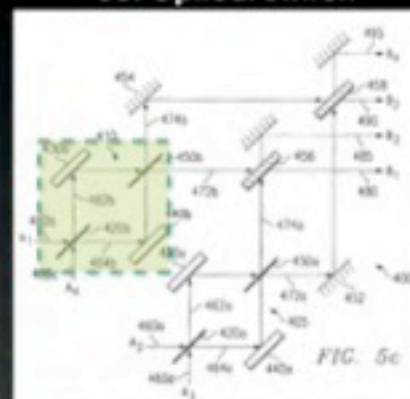
The '862 Patent Changes Amplitude Only by Using Phase Shift and Interference



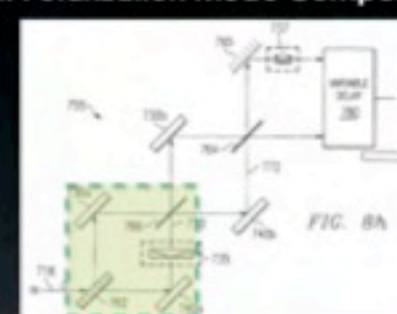
Every Embodiment of the '862 Patent Uses Phase Shift and Interference to Change Amplitude



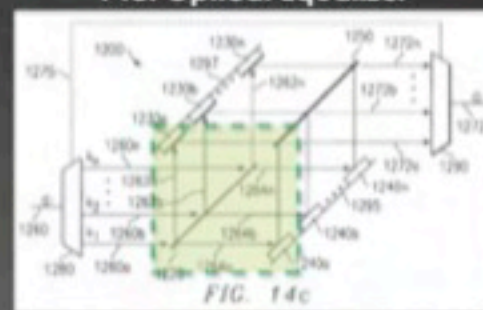
5c: Optical Switch



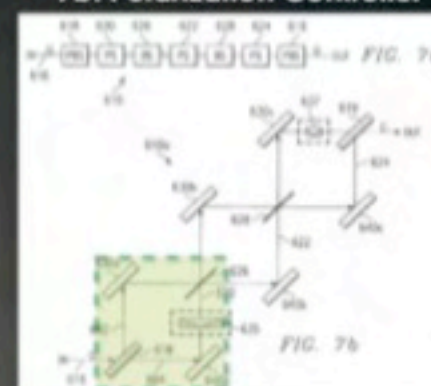
8h: Polarization Mode Compensator



14c: Optical Equalizer



7b: Polarization Controller



16d: Add/drop Multiplexer



10b: Polarization Controller Array



Every Embodiment of the '862 Patent Uses Phase Shift and Interference to Change Amplitude

- ➡ **Cheetah's reply brief does not deny that every embodiment in the '862 patent works this way**

See Reply Br. at 7.

- ➡ **Cheetah nowhere identifies any other method described or enabled by the '862 patent**

Federal Circuit: Claims are Limited to What is Taught in the Specification



On Demand Mach. Corp. v. Ingram Indus., Inc., 442 F.3d 1331, 1338 (Fed. Cir. 2006) (“[T]he scope and outer boundary of claims is set by the patentee’s description of his invention.”).



Federal Circuit: “Customer” meant “retail customer” when written description discussed only retail customers.

Federal Circuit: Claims are Limited to What is Taught in the Specification



Nystrom v. TREX Co., 424 F.3d 1136 (Fed. Cir. 2005)

(the patentee is "not entitled to a claim construction divorced from the context of the written description and prosecution history").



Federal Circuit: The claim term "board" meant wooden board when every embodiment involved a wooden board.

Plurality of Wavelengths

'862 Claim 13: “Plurality of Wavelengths”

13. A method of processing multiple wavelengths of light, the method comprising:

. . . communicating an optical signal for processing, the optical signal comprising a plurality of wavelengths

'862 Claim 13: "Plurality of Wavelengths"

| Cheetah's Construction | Defendants' Construction |
|------------------------------------|--|
| Light of more than one wavelength* | Comprising multiple communication channels |

*Cheetah construes the entire phrase "an optical signal for processing, the optical signal comprising a plurality of wavelengths" to mean "light of more than one wavelength."

Cheetah's Construction is No Construction

| Claim Term | Cheetah's Construction |
|-----------------------------|-----------------------------|
| plurality of wavelengths | more than one wavelength |

'862 Claim 13: Separating into “Wavelengths”

13. A method of processing multiple wavelengths of light, the method comprising:

... separating the optical signal communicated for processing into at least a first portion of optical signal wavelengths and a second portion optical [sic] signal **wavelengths . . .**

'862 Claim 13: Separating into “Wavelengths”

Cheetah's Construction

Separating the optical signal into two or more wavelengths

Defendants' Construction

Separating the “optical signal” into at least two groups of wavelengths, each containing different communication channels

The '862 Patent Uses "Wavelengths" to Mean "Channels"

US 7,116,862 B1
1
APPARATUS AND METHOD FOR
PROVIDING GAIN EQUALIZATION

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In one aspect of the invention, a gain equalizer comprises
a wavelength division demultiplexer operable to separate
one or more communication bands into a plurality of wave-
lengths and an array of phase shifter stages. Each phase
shifter stage is operable to selectively introduce attenuation or gain
into each wavelength.

BACKGROUND OF THE INVENTION

Processing, that can be used to provide gain equalization in a multiple wavelength system, is disclosed in U.S. Pat. No. 6,415,488, entitled "Apparatus and Method for Providing Gain Equalization in a Multiple Wavelength System".

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multiple wavelength systems. This problem becomes increasingly acute as optical systems strive to implement more and more wavelength channels.

wavelength to be attenuated. Although some systems exist for providing attenuation in optical signals, no system has emerged that provides cost effective attenuation in multiple wavelength systems. This problem becomes increasingly acute as optical systems strive to implement more and more wavelength channels.

One particular problem that can arise in an optical communication system supporting many wavelengths involves controlling the gain tilt in the transmitted signal. Existing optical communication systems have typically been limited to using the conventional ("C") band of wavelengths to communicate optical signals. With the increasing demand for bandwidth, the capacity of communication systems is being expanded by the addition of new communication bands. For example, future communications systems will likely use the long wavelength ("L") band and possibly even the short wavelength ("S") band.

As additional wavelength bands are utilized and the net power in the fiber is increased, a problem can arise from an inter-channel Raman effect. In particular, longer wavelength channels can rob power from the shorter wavelength channels, creating a gain tilt after propagation through the fiber. The gain tilt can become increasingly pronounced as links of amplified fiber segments are cascaded.

SUMMARY OF THE INVENTION

The present invention recognizes a need for a method and apparatus operable to economically provide gain equalization in a multiple wavelength optical signal.

Processing, that can be used to provide gain equalization in a multiple wavelength system, is disclosed in U.S. Pat. No. 6,415,488, entitled "Apparatus and Method for Providing Gain Equalization in a Multiple Wavelength System".

In still another aspect of the invention, a multiple band optical communication system comprises a plurality of optical amplifiers coupled in parallel, each operable to receive and amplify one of a plurality of communication bands, each communication band comprising a plurality of wavelengths. The system further comprises a gain equalizer coupled to at least one of the plurality of optical amplifiers, the gain equalizer comprising a plurality of equalizing stages each operable to receive one of the plurality of amplified wavelengths and to selectively introduce attenuation or gain into each wavelength.

Depending on the specific features implemented, particular embodiments of the present invention may exhibit some, or all of the following technical advantages. One aspect of the present invention provides an effective and cost efficient mechanism for facilitating gain equalization in a multiple wavelength optical communication system. In a particular embodiment, implementing MEMS based attenuation stages facilitates fabrication of arrays of these devices at an incremental additional cost to fabricating a single attenuation stage. This aspect of the invention provides significant advantages in facilitating rapid, effective, and economical gain equalization, particularly in an environment supporting numerous wavelengths.

Another aspect of the invention provides an effective and cost efficient mechanism for dynamically adjusting the gain

The '862 Patent Uses "Wavelengths" to Mean "Channels"

1 APPARATUS AND METHOD FOR PROVIDING GAIN EQUALIZATION

RELATED APPLICATIONS

This application is a continuation of application Ser. No. 10/733,007, entitled "Apparatus and Method for Providing Gain Equalization," filed on Dec. 22, 2000.

US 7,116,862 B1

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In one aspect of the invention, a gain equalizer comprises a wavelength division demultiplexer operable to separate one or more communication bands into a plurality of wavelengths and an array of phase shifter stages. Each phase shifter stage comprises a micro-electro-optic system (MEMS) device comprising a movable mirror layer operable to receive a first copy of an input signal from a beam splitter and to reflect the first copy of the input signal to an

BACKGROUND OF THE INVENTION

Pat. No. 5,820,000, and an application for Add'l Dep. Mat. 2000/010,000, both of which are hereby incorporated by reference.

In another aspect of the invention, a gain equalizer comprises gain equalization of a plurality of wavelengths comprising a plurality of receiving an optical input signal comprising a plurality of wavelengths, separating the optical signal into a plurality of

power in the fiber is increased, a problem can arise from an inter-channel Raman effect. In particular, longer wavelength channels can rob power from the shorter wavelength channels, creating a gain tilt after propagation through the fiber.

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Another aspect of the invention provides an effective and cost efficient mechanism for dynamically adjusting the gain

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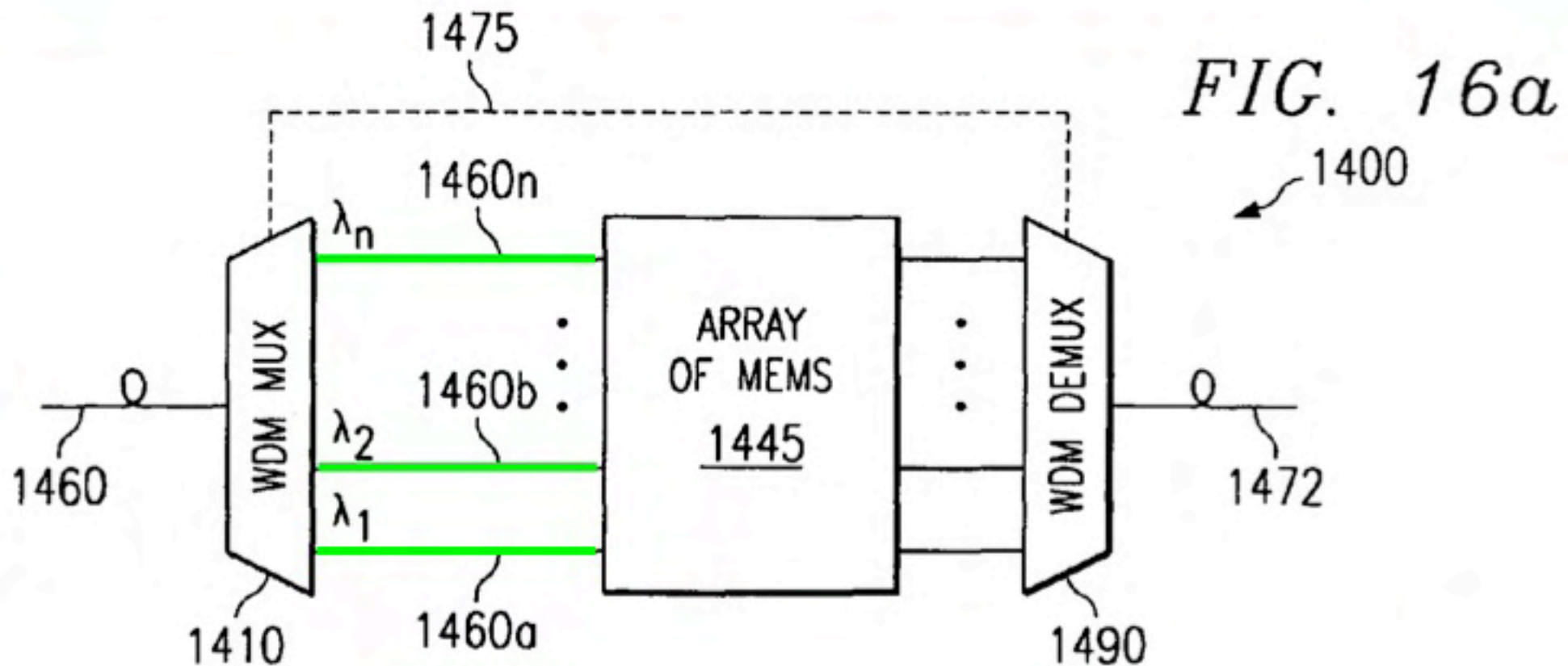
through 922 have described one example of a method of crosslinking relaxation in an optical signal. This method

Polarization beam splitter 609 resolves phase into principal modes of polarization 662 and 664 and separates the principal modes of polarization at step 922. Steps

In the illustrated embodiment, system 300 further includes a wavelength division demultiplexer 307 coupled to the output of delay element 312, and an array of filters 323. Wavelength division multiplexer 307 is operable to receive a compounded signal 317 from delay element 312, separate the various wavelengths of that signal, and direct those wavelengths to a detector 323. Detector 323 converts the optical signals received into electrical signals for

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The '862 Patent Separates Wavelength Channels for Processing



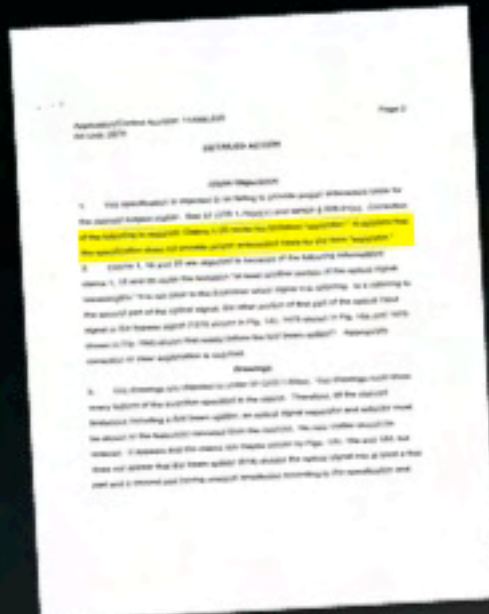
an exemplary system 1400 operable to perform wave division add/drop multiplexing. System 1400 includes a wave division demultiplexer 1410 operable to receive an optical signal 1460 and to separate optical signal 1460 into a plurality of wavelengths 1460a–1460n. System 1400 further

The Prosecution History Confirms that the “Separating” Step Operates on Wavelength Channels

Examiner Statement:

It appears that

the specification does not provide proper antecedent basis for the term “separator.”

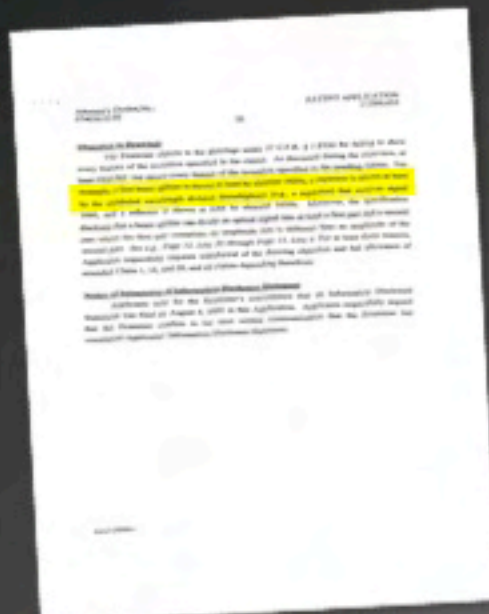


Office Action (mailed Aug. 5, 2005)

Islam and Kuditcher Statement:

a separator is shown at least

by the unlabeled wavelength division demultiplexer



Response (Nov. 1, 2005)

The Prosecution History Confirms that the “Separating” Step Operates on Wavelength Channels

Islam and Kuditcher Statement:

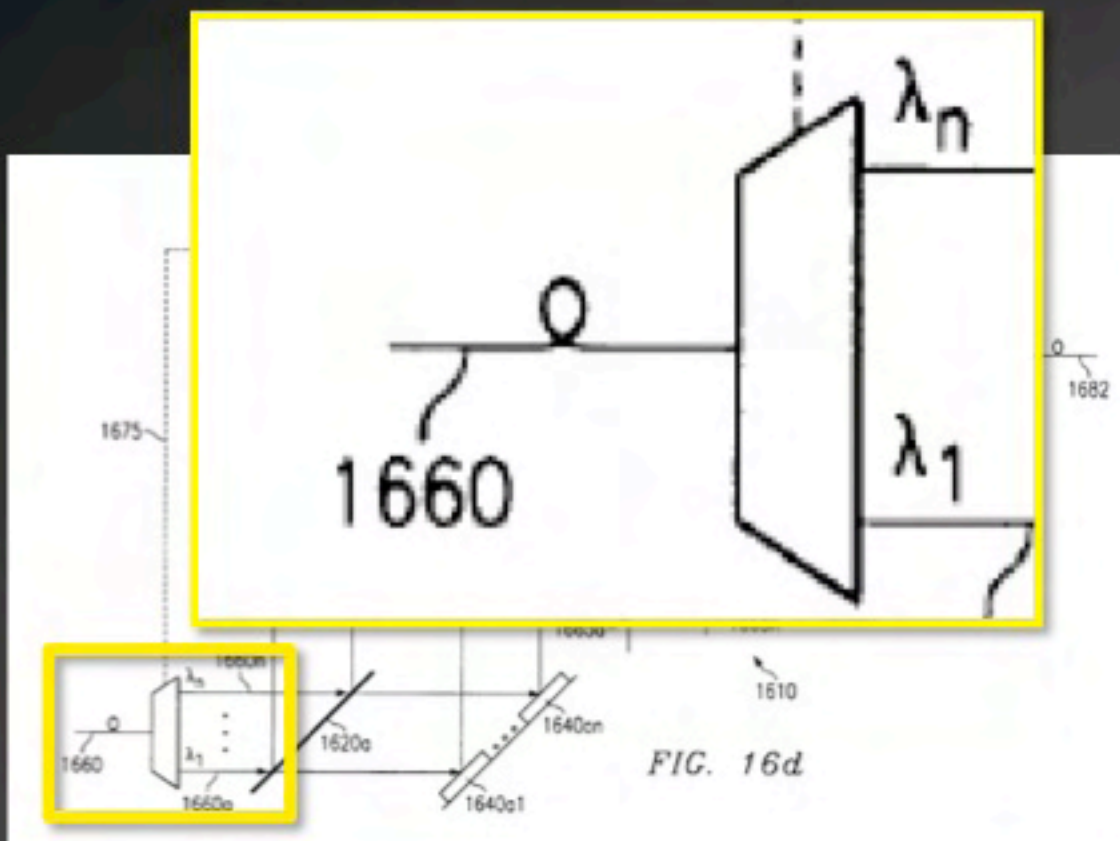
by the unlabeled wavelength division demultiplexer

a separator is shown at least

demultiplexing: The separation of two or more **chan-**
nels previously multiplexed, i.e., the reverse of multi-
plexing. *Common abbreviation: deMUXING. Syn-*

Weik, Fiber Optics Standard Dictionary 209 (3d ed. 1997)

Response (Nov. 1, 2005)



Light Pipe

'714 Claim 18: "Light Pipe"

18. A light processing system, comprising:

... a **light pipe** operable to communicate at least the first signal part for processing

'714 Claim 18: "Light Pipe"

| Cheetah's Construction | Defendants' Construction |
|--------------------------------------|--------------------------|
| An optical fiber or waveguide | Fiber-optic line |

Cheetah's Construction Does Not Help the Jury

Cheetah's Construction: “an optical fiber **or waveguide**”

What is a “waveguide”?

Cheetah's Construction is Inconsistent with the '714 Patent

The '714 Patent only uses the term “light pipe” once outside of the claims

This usage is simply a reiteration of the claim language:

into a first signal part and a second signal part. The system also comprises a **light pipe** that is operable to communicate at least the first signal part for processing. The system further

'714 Patent, Col. 1, ll. 52-54

"Light Pipe" Means "Optical Fiber"

NEWTON'S TELECOM DICTIONARY

also NECA, Separations and Settlements, and Universal Service.

LIFO Last In First Out. A method of organizing queues. See Last In First Out.

Liftoff A term referring to the moment a spacecraft first rises from the ground after its launch. "Five, four, three, two, one, liftoff," the now famous rocketry countdown, was invented by the German director Fritz Lang as a suspense builder for his 1929 science-fiction movie, "Die Frau im Mond," or "The Woman in the Moon," (a.k.a. "By Rocket to the Moon"). A young engineering student, Wernher von Braun, was impressed by the movie, and when he began work on the V-1 and later the V-2 rocket, used it. Later, after the second World War ended and he and some of his colleagues were

brought to the U.S. to continue their down became a familiar part of the sp

Light Technically, light is electromagnetic radiation with properties similar to the invisible near-infrared "light" (or radiation) that carries signals in most fiber systems. Light consists of electrically applied to those having a wave cm. (the red ray) to .000008 cm. (the

Light Amplification of Stimulated Emission of Radiation LASER. A device which transmits a narrow beam of electromagnetic energy in the visible light spectrum. The light waves are in phase with one another, or coherent, rather than jumbled as in normal light. See Laser.

Light Emitting Diode See LED.

Light Pen A video terminal input device which is a light sensitive stylus connected by a cable to the video terminal. The user brings it to the desired point on the screen surface and presses a button. A light pen is used to select options from a menu on the screen or to draw images by dragging the cursor around the screen on a graphics terminal.

Light Piping Use of optical fibers to illuminate.

Light Year The distance that light travels in a pure vacuum (e.g., outer space) during a year. It's a big number. (Do the math: 186,000 miles per second x 60 seconds per minute x 60 minutes per hour x 24 hours per day x 365 days per year = 5,865,696,000,000 miles (that's almost six trillion miles). All wave forms in the electromagnetic spectrum propagate at roughly this speed, assuming they are unimpeded by physical matter such as copper wires, earth's atmosphere or glass fibers. Such physical matter not only slows the rate of travel as a result of resistance, but also creates distortion in the signal. See Fiber Optics and Loss.

Lightwave Communications Fiber Optic communications using light to carry information.

Lightwave Transmission This term now means laser communications systems shot through the air (as opposed to glass fibers). Also called "free space lightwave communications." Typically, a signal is radiated directly from a transmitter to a receiver less than a mile away. Advantages to lightwave transmission: easy to install, no digging of cables, wide bandwidth, reliable, cheap, no FCC frequency clearance approvals required and the receiving and transmitting equipment occupy little space. Disadvantages: only works for a mile or so and is subject to attenuation (fading) from fog and dust. It's perfect for between downtown buildings, where installing cables is too expensive, too cumbersome, too slow, etc. See Laser.

LJP An ATM term. Leaf Initiated Joint Parameter: Root

screening options and Information Element (IE) instructions carried in SI/TUP message.

Like New A term used in the secondary telecom equipment business. It means in excellent condition. Under normal conditions, the like new equipment could pass as new (i.e., not used, but not necessarily in the O.E.M. packaging). See Like New Repair Update.

Like New Repair And Update (LNRU). A term in the industry which repairs telecom equipment. It means all equipment is repaired and updated to the current manufacturer's specifications. New plastic is used to refurbish to a "like new" status. Also added are a new coil cord, line cord and address tray. Included is a full diagnostic test with a burn-in (if required) and an operational system test. Definition courtesy Nittoku America. See also Repair and Quick Clean and

Light Piping Use of optical fibers to illuminate.

of the lig, upwards would be called "sky-livered."

LIM Link Interface Module.

LIM-EMS The abbreviation for Lotus Intel Microsoft Expanded Memory Specification. A software technique that allows MS-DOS to access memory beyond one megabyte by mapping the memory into a window in an area that MS-DOS can access. LIM-EMS is one of the greatest techniques for ram access. LIM-EMS is not run when my calendar program called Maxi-Calendar is not running. It occupies only 7K of normal RAM and 350K of expanded RAM. When I need it, it swaps itself quickly out of expanded RAM into normal RAM, taking less than half a second. If I didn't have expanded memory, it would take as long as 15 seconds to swap the program onto and off my hard disk, which is the other alternative. LIM stands for Lotus/Intel/Microsoft, the founding organizations that developed the Expanded Memory Specification. AST Research was also part of the driving force behind EMS, though its name doesn't appear in the acronym.

Limited Distance Modem (LDM). A special purpose conversion device designed to connect two DTEs (data communication devices) over a relatively short distance, typically up to several miles. An LDM is not really a modem since it does not perform a digital-to-analog conversion, but transmits a special type of digital signal to the other LDM on the circuit. Also called a line driver, local datalink or short-haul modem.

Limiter A circuit which shapes a signal sent through it to conform to certain preset tolerances, used in both audio and video to regulate signal flow and prevent overloading, which would lead to distortion and the introduction of spurious noise.

Limiting Amplifier Relating to analog signals and their processing. Also refers to the operating range of an amplifier where little or no distortion occurs.

LINKS Leased Interfacility National Airspace Communications System.

Line The word line is confusing. In traditional telecom, a line is an electrical path (two wires) between a phone company central office and a subscriber, usually with an individual

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SAMSUNG-MIT-002-0000202

"Light Pipe" Means "Optical Fiber"

The fiber-optics textbook cited by Cheetah for 'light pipe' actually supports Defendants' construction:

However, there also are times when people want to look around corners or probe inside places that are not in a straight line from their eyes. Or they may just need to pipe light from place to place, for communicating, viewing, illuminating, or other purposes. That's when they need fiber optics.

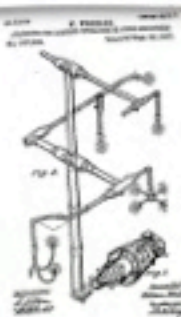
In 1881, a Concord, Massachusetts, engineer named William Wheeler patented a scheme for piping light through buildings.

...
enough light to do the job. However, the idea of light piping reappeared again and again until it finally coalesced into the optical fiber.

Kopykake Enters., Inc. v. Lucks Co., 264 F.3d 1377, 1383 (Fed. Cir. 2001)

("we consider the meaning of the claim as of the date the invention was constructively reduced to practice -- the date the patent application was filed.")

Jeff Hecht, Understanding Fiber Optics 2-3 (4th ed. 2002)



Although he was in the service when he received his patent, Wheeler had already helped found a Japanese engineering school. He had founded a successful company that made water pumps, and more and more he became a widely known hydraulic engineer. However, light piping was one of his passions. (Inventors had long known that light could be reflected off a surface. Even if they had, Wheeler's light pipe probably wouldn't have reflected light in one way. Even if they had, Wheeler, the idea of light piping emerged again and again until it finally coalesced into the optical fiber.)

'714 Patent Uses an Optical Fiber to Communicate an Optical Signal for Processing

Cheetah does not dispute these are the only "light pipes" arguably present in the '714 patent

a **light pipe** operable to communicate at least the first signal part for processing;

example, OC-48 and OC-192 or higher. In the illustrated embodiment, communication link **1020** comprises a **single mode fiber**

Electro-optic switch includes a **fiber optic tap** operable to communicate a first portion of optical signal **1012** to a delay line **1022** and a second portion of optical signal **1012** to a demultiplexer **1024**.

'714 Patent, col. 25 ll. 43-44.

'714 Patent, col. 20 ll. 31-32, 36-39.